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Original Research Article

Outcome of Posterior Malleolus Fracture Fixation with Screws, Plates and Treatment in Ankle Fractures at a Hospital Based Prospective Observational Study

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Abstract

Background: Ankle fractures represent 10% of all skeletal injuries, with an incidence rate of 187 cases per 100,000 people, predominantly affecting individuals aged 60 to 69, especially women over 60 who are more prone to open fractures. This study aims to assess the functional outcomes related to posterior malleolus fractures specifically, exploring various treatment options including the use of screws and plates, and evaluating the resultant range of motion.

Methods: This hospital-based observational study conducted at Department of Orthopaedics, Autonomous state medical college, Hardoi, Uttar Pradesh over a period one year. Patients' posterior malleolar fractures were divided into three treatment groups: conservative, screw-fixed, and plate-fixed. Functional scoring system to assess pain, ankle stability, ability to walk, run, and work, ankle motion, and radiographic results. Total 90 patients aged 18-70 years, either sex, fit for surgery, and eager to participate in the study.

Results: Total of 90 patients in three treatment groups 30 each (33.33%). The primary injury mechanism was Motor Vehicle Accident, along with other causes like Twisted Ankle and Jump. The distribution of osteoarthritis grades varied, with Group 1 showing the most common grade. Surgical duration, ankle hindfoot scores, and VAS scores were compared, with Group 3 showing the highest improvement and Group 2 the least. Mean VAS scores decreased across all groups without significant baseline differences. Outcomes distribution was analyzed, revealing 20.00% excellent outcomes in the non-surgical group, while Group 2 had the highest excellent outcome percentage.

Conclusion: Plate fixation demonstrated superior functional outcomes for posterior malleolar fractures compared to screw fixation and conservative treatment, which showed the least improvement.

Keywords: Ankle Fracture, Posterior Malleolus fracture, Screw, Plates.

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Introduction

Ankle fractures account for 10% of skeletal injuries, with an incidence of 187 per 100,000 people annually. They primarily affect the lateral and medial malleoli and can lead to trimalleolar fractures.[1,2] The highest incidence occurs in individuals aged 60-69, especially women over 60.[3-5] Proper stability and alignment must be restored via surgical or non-surgical methods, and immobilization is critical for dislocation management. The posterior malleolus is vital for joint stability and tendon attachment; its fracture alters joint mechanics and raises the risk of post-traumatic osteoarthritis. Surgical treatment is typically necessitated for fractures affecting 25%-33% of the articular surface or with a displacement greater than 2 mm.[6-8] Recent studies highlight the importance of maintaining syndesmotic stability and the role of the posterior malleolus in preventing complications.[9] Advances in understanding have prompted a re-evaluation of therapeutic approaches for fractures, particularly screw fixation and plate fixation. Screw fixation techniques include anterior-posterior and posterior-anterior methods, while plate fixation facilitates direct visualization and fracture reduction. For smaller, non-displaced fractures, conservative treatment is suitable; however, non-surgical therapy may result in poorer outcomes.[10,11] A study by

Teimouri et al. revealed no significant difference in functional outcomes between screw and plate fixation in posterior malleolar fractures, underscoring the necessity for personalized treatment strategies.[12] Espinosa-Uribe et al.[13] found that there is no significant difference in the development of postoperative ankle osteoarthritis between the use of cannulated screws and plate fixation, indicating that both methods are viable alternatives for treatment. The approach to managing posterior malleolus fractures has advanced by taking into account factors such as fracture morphology and patient characteristics, along with both surgical and conservative treatment strategies. Ongoing research and improvements in imaging and surgical techniques are contributing to better functional outcomes and reduced complications for patients with complex injuries. The study aims to evaluate the functional outcomes of posterior malleolus fractures in ankle injuries using screws, plate, and conservative treatment, focusing on time required for union and range of movements.

Methods

The hospital-based observational study was conducted at Department of Orthopaedics, Autonomous state medical college, Hardoi over a period one year. Posterior malleolar fractures patients were divided into three treatment groups: conservative, screw-fixed, and plate-fixed. Functional scoring system to assess pain, ankle stability, ability to walk, run, and work, ankle motion, and radiographic results. Total 90 patients aged 20-70, either sex, fit for surgery, and eager to participate in the study. The study excludes individuals aged 20-70, unwilling to participate, unfit for surgery, or allergic to anesthesia for fixation groups.

Study compares and analyzes the functional outcomes of posterior malleolus fractures by fixation with screws, plate, and conservative treatment in an ankle injury.

The maximum follow-up period after surgical management is six months. Patients were divided into three groups based on the results of the radiological reports: group I received conservative care, group 2 had the posterior malleolus fixed with screws, and group 3 had the posterior malleolus fixed with plates. Prereduction radiography was performed on all patients at the time of presentation, and ankle X-rays in the AP and lateral views were used to confirm the fracture. Patients would also have a CT scan of the ankle joint to determine the size and location of a posterior malleolar fracture fragment. Patients were divided into three groups based on the results of the radiological reports: group I received conservative care, group 2 had the posterior malleolus fixed with screws, and group 3 had the posterior malleolus fixed with plates. In the surgical groups, patients using various approaches to correct the posterior malleolar fragment would use antero-posterior screws and plates. Along with treating the posterior malleolar fragment, the posterolateral incision was also treated for the fibula fracture, and a separate medial approach was performed to treat the medial malleolus. Medial and lateral malleoli in group I were fixed using a traditional medial and lateral technique. There are several ways to treat an associated medial or lateral malleolus fracture. If the posterior malleolar fracture is diminished after lateral malleolus fixation, it is treated cautiously.

Three surgical techniques were used to address posterior malleolar fractures. The posterior-lateral approach involved a prone position, a longitudinal incision, and careful dissection while safeguarding key structures, allowing for the reduction and fixation of the fragment with a plate. Screw fixation was performed with the patient supine, reducing the fragment after dorsiflexion of the ankle. Post-surgery, group 1 wore a below-the-knee slab for six weeks, whereas groups 2 and 3 did not need immobilization due to no direct repair of their fragments. The study assessed radiological healing, functional outcomes, complications, weight-bearing times, and return to activity. The study 24th version SPSS software to analyze patient demographics and clinical characteristics, comparing qualitative and quantitative variables. It also investigated the association between surgical treatment results of posterior malleolar fractures with screw fixation and plate fixation.

Results

Total of 90 patients were divided into three treatment groups of 30 each. The mean ages were comparable: 34.24±10.52 years for Group 1, 38.64±10.40 years for Group 2, and 37.44±11.50 years for Group 3. The gender distribution was 72% male and 48% female.

The leading cause of injury was Motor Vehicle Accident (40% Group 1, 43.33% Group 2, 40% Group 3), with no statistically significant differences in injury mechanisms found among groups. Regarding osteoarthritis (OA), Group 1 had 40% with Grade 0, Group 2 had 33.33%, and Group 3 had 36.67%. The most common OA grade was Grade 1, present in 43.33% of Groups 1 and 3, and 50% of Group 2. Grade 2 OA was noted in 13.33% of Groups 1 and 3, and 16.67% in Group 2. (Table 1)

Table 1: Comparison of Gender distribution, Mena Age, Mechanism of injury, Displacement status of fractures, Grades of Osteoarthritis among the three groups

	Group 1 (n=30)		Group 2 (n=30)		Group 3 (n=30)		Chi Sq.	p-Value
Gender	**n**	**%**	**n**	**%**	**n**	**%**		
Male	18	72.00	18	72.00	16	64.00	0.36	0.833
Female	12	48.00	12	48.00	14	56.00		
Age in years (mean±SD	34.24±10.52		38.64±10.40		37.44±11.50		F=1.11	0.335
Mechanism of injury								
Twisted Ankle	8	26.67	9	30.00	7	23.33	3.97	0.849
Motor Vehicle Accident	12	40.00	13	43.33	12	40.00		
Plantar Flexion	2	6.67	2	6.67	4	13.33		
Supination Eversion	1	3.33	1	3.33	1	3.33		
Jump	3	10.00	4	13.33	2	6.67		
Unknown	4	13.33	1	3.33	4	13.33		
Displacement status of fractures								
Yes	4	13.33	2	6.67	3	10.00	0.74	0.691
No	30	100.00	28	93.33	27	90.00		
Osteoarthritis (OA)								
Grade 0	12	40.00	10	33.33	11	36.67	4.49	0.611
Grade 1	13	43.33	15	50.00	13	43.33		
Grade 2	4	13.33	5	16.67	4	13.33		
Grade 3	0	0.00	0	0.00	2	6.67		
Grade 4	0	0.00	0	0.00	0	0.00		

The study analyzed surgery duration and functional outcomes among four groups. Group 1 underwent no surgery, while Groups 2 and 3 had mean surgery durations of 96.84 minutes and 94.48 minutes, respectively, with Group 4 averaging 77.56 minutes. Follow-up scores indicated significant improvement, particularly in Group 3 (treated with plates), followed by Group 2 (screws), and least in Group 1 (conservative treatment).

VAS scores improved in all groups, with baseline scores showing no significant differences; at follow-up, differences in VAS scores remained statistically insignificant. (Table 2)

Table 2: Comparison of Duration of Surgery (min), AOFAS (American Orthopaedic Foot and Ankle Society) ankle hindfoot scores and VAS scores for pain across the three groups at baseline and follow-up

	Group 1 (n=30)	Group 2 (n=30)	Group 3 (n=30)	F	p-Value
	Mean±SD	**Mean±SD**	**Mean±SD**		
Duration of Surgery (min)	-	96.84±14.10	94.48±21.70	77.56	0.570
AOFAS ankle hindfoot scores					
At Baseline	22.16±6.36	21.56±6.06	21.00±5.12	0.24	0.784
At Follow-up	79.20±14.09	88.88±10.37	92.64±4.87	10.94	<0.001
VAS scores for pain					
At Baseline	5.76±1.45	5.88±1.13	5.52±0.82	0.62	0.540
At Follow-up	1.64±0.76	1.16±0.99	1.40±0.82	1.95	0.149

The study analyzed the duration of hospital stays in three groups, with Group 2 having a mean stay of 9.80 ± 1.85 days and Group 3 having a mean stay of 9.44 ± 1.26 days. The results showed no statistically significant difference in hospital stay duration between the groups.(Table 3)

Table 3: Comparison of mean duration of hospital stay among the three groups

	Group 1 (n=30)	Group 2 (n=30)	Group 3 (n=30)	F	p-Value
	Mean±SD	**Mean±SD**	**Mean±SD**		
Hospital stay (days)	-	9.80±1.85	9.44±1.26	0.41	0.667

The study analyzed the distribution of outcomes across three groups: non-surgical, surgical, and good/poor.

Non-surgical group had 20.00% excellent outcomes, 66.67% good, 10% fair, and 3.33% poor outcomes. Group 2 had the highest percentage of excellent outcomes (50.00%), with 46.67% classified as well and 3.33% as fair. Group 3 had the highest percentage (53.33%), with 43.33% classified as well and 3.33% as fair.

No poor outcomes were observed in Groups 2 and 3. (Table 4)

Table 4: Comparison of distribution of outcomes across the three groups

Outcome	Group 1 (n=30)		Group 2 (n=30)		Group 3 (n=30)		Chi Sq.	p-Value
	n	%	n	%	n	%		
Excellent	6	20.00	15	50.00	16	53.33	11.35	0.101
Good	20	66.67	14	46.67	13	43.33		
Fair	3	10.00	1	3.33	1	3.33		
Poor	1	3.33	0	0.00	0	0.00		

Discussion

Posterior malleolus fractures, significant in complex ankle injuries, affect stability and long-term outcomes. Traditionally treated conservatively based on size, modern evidence advocates for anatomical reduction and stable fixation. This study assesses outcomes of surgical fixation versus non-operative management of these fractures at a tertiary care center, noting demographic trends similar to prior research, with higher incidence among adults experiencing high-energy trauma. It reinforces the correlation between posterior malleolus involvement and severe injury patterns, emphasizing increased rotational instability. This study found mean age of participants in group 1 (conservative therapy) was 34.24 ± 10.52 years, group 2 (screw fixation) was 38.64 ± 10.40 years, and group 3 (plate fixation) was 37.44 ± 11.50 years. Age did not affect treatment outcomes, as the study groups were similar in age. Previous studies have found that posterior ankle fractures can occur at any age, possibly due to more comorbidities or osteoporosis-related fracture susceptibility.[14] Posterior malleolar fractures are common in active middle-aged people, especially in high-energy trauma like car accidents. Studies have also found similar average age in fixation methods, with middle-aged patients often undergoing surgery to improve functional outcomes.[15-17] Teimouri et al. reported similar average age in their screw and plate fixation groups.[12]

The study found that gender distribution in three treatment groups was evenly distributed, with males accounting for 72.0% and females 48.0% in Group 1 (conservative treatment) and Group 2 (screw fixation). In Group 3, males comprised 64.0% and females 56.00%. No significant difference in gender distribution was found, indicating that gender does not significantly affect treatment outcomes in posterior malleolar fractures. This finding aligns with previous studies indicating male predominance due to high-energy trauma exposure.[18]

In our study, motor vehicle accidents were the predominant source of injury, including 40.00% in group 1 (conservative therapy), 43.33% in group 2 (screw fixation), and 40.00% in group 3 (plate fixation), with no statistically significant differences found. Some studies found that high-energy trauma, particularly motor vehicle accidents, as the primary cause of posterior malleolar fractures, highlighting their prevalence in active, younger individuals.[16,19]

The study found that fracture displacement was observed in 13.33% of cases in group 1 (conservative treatment), 6.67% in group 2 (screw fixation), and 10% in group 3 (plate fixation). However, the majority of fractures were not displaced in all groups, with no significant difference in displacement. This finding is consistent with previous studies, found that plate fixation resulted in better anatomical reduction and lower residual displacement rates compared to screws. [14,16,20] Displaced fractures are more likely to lead to complications like osteoarthritis if not treated appropriately.

The study found that osteoarthritis (OA) grades were evenly distributed among patients, with grade 0 OA most frequently occurring in group 1 (conservative treatment), followed by grade 1 OA in groups 1 and 3, grade 2 OA in groups 1 and 3, and grade 3 OA in group 3. No patient had grade 4 OA, and no significant differences were found in the distribution of OA grades between the groups. This finding is consistent with previous studies, which highlighted the importance of anatomical reduction in minimizing the risk of OA. [14,16,20,21] The study's lack of significant differences in OA grades suggests that the choice of treatment, whether conservative, screw fixation, or plate fixation, did not significantly impact the development of OA within the follow-up period.

The study found that surgery durations for plate and screw fixation were 96.84 and 94.48 minutes, respectively, with comparable durations due to additional intervention. Plate fixation and screw fixation require longer surgical durations due to the complexity of achieving anatomical reduction and stabilization, but these longer times are justified by improved functional outcomes. Studies have found comparable operative times for screw and plate fixation due to similar procedural requirements.[12,14,16] However, no significant differences were found between screw and plate fixation groups, emphasizing the meticulous alignment and fixation steps involved. The study found that the mean AOFAS scores for the hind ankle at baseline were 22.16 ± 6.36, with

significant improvement at follow-up. Plate fixation provided the best functional outcomes, followed by screw fixation, while conservative treatment was associated with the least improvement. Anatomical reduction significantly influenced functional recovery, and both screw and plate fixation improved outcomes, with plates tending to provide better stability. Researchers have reported similar improvements in AOFAS scores after surgical treatment, with an average score of 90 points. However, in cases with fragment sizes <15%, plates had significantly lower AOFAS scores compared to screws, suggesting that it is beneficial to match the surgical approach to the fracture size.[14,16] No significant differences in Foot and Ankle Outcome Scores (FAOS) between the screw and plate fixation groups were observed, but both showed significant improvement over conservative treatment. Anatomical reduction is essential for improving functional outcomes, and patients treated with plate fixation showed better SMFA and AOFAS scores compared to screw fixation. Inadequate reduction, particularly with conservative treatment, leads to poorer functional outcomes and a higher risk of complications.[12,21-23]

The study found no significant differences in VAS values between groups at the beginning of the study. The mean scores were 5.76 ± 1.45 in group 1 (conservative treatment), 5.88 ± 1.13 in group 2 (screw fixation), and 5.52 ± 0.82 in group 3 (plate fixation). At follow-up, VAS scores decreased in all groups, but no significant differences in follow-up pain scores were found. Post-hoc analysis confirmed that there were no significant differences at baseline or follow-up, so pain scores were comparable across groups. Similar studies were reported the importance of anatomical reduction for pain relief.[12,14,16,20] All groups showed significant pain reduction with no significant differences between groups at follow-up. The study supports the findings that both screw and plate fixation methods are effective in reducing pain in posterior malleolar fractures.

The study found a significant difference in range of motion (ROM) between conservative and screw fixation groups, with group 3 achieving the highest ROM, followed by group 2 and group 1, and the conservative group having the lowest ROM. However, no significant differences were found in the length of hospital stay between the surgical groups. The mean hospital stay in Group 2 was 9.80 ± 1.85 days, while in Group 3, it was 9.44 ±1.26 days. The F-value of 0.41 and p-value of 0.667 indicate no statistically significant difference in hospital stay duration between the surgical groups, suggesting that both screw and plate fixation approaches lead to similar hospitalization periods. The relatively similar duration of hospitalization across the surgical groups implies that post-operative recovery time is comparable between screw and plate fixation techniques. Ceccarini et al. reported that most patients (40.8%) maintained full joint range of motion after surgical treatment, with plate fixation resulting in better ROM.[14] Kalem et al found that patients treated with plate fixation had better ROM than patients treated with screws, particularly in terms of dorsiflexion.[20] Wang et al reported comparable outcomes, with ROM being highest in patients treated with plates and slightly lower in screw fixation groups.[16]

The study found that the distribution of clinical outcomes varied across three groups: plate fixation (Group 3), screw fixation (Group 2), and conservative treatment (Group 1), with Plate fixation showing the highest percentage of excellent outcomes (53.33%) and screw fixation at 50.00% respectively. Only 20% of patients in conservative treatment achieved excellent outcomes, with a larger proportion of patients in the conservative treatment group having good or fair outcomes. Neither surgical group had poor outcomes, indicating the potential advantage of surgical fixation in achieving better functional results. Similar trends were observed in various studies highlights the importance of surgery in achieving favorable outcomes.[12,14,16,20] This study found no poor outcomes in the surgical groups, indicating the potential advantage of surgical fixation in achieving better functional results.

The study found that surgical fixation, especially with plates, leads to better outcomes in treating posterior malleolar fractures, contrasting with conservative therapy. Although statistical differences were not significant, the findings align with existing literature. However, limitations like small sample size, insufficient follow-up, single center bias, and surgeon expertise may affect the findings' generalizability.

Conclusion

A study comparing conservative treatment, screw fixation, and plate fixation for posterior malleolar fractures found that surgical interventions, particularly plate fixation, resulted in better functional outcomes. Plate fixation achieved the best overall outcomes, followed by screw fixation, while conservative treatment showed the least improvement. Plate fixation consistently provided the most favorable results in terms of functional recovery and stability. Conservative treatment had the lowest rates of excellent outcomes and the highest proportion of mediocre and poor outcomes.

Future studies should validate these findings and establish standardized guidelines for posterior malleolar fracture treatment.

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